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# The Role of Airpower in the Overlord Invasion

## An Effects-based Operation

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## The Role of Airpower in the Overlord Invasion: An Effects-based Operation

Conventional wisdom has long held that the strategic airpower supporting the Normandy landings on D-Day was generally ineffective. Time and again, the OVERLORD researcher is told that the Eighth Air Force failed to provide the landing troops, particularly on Omaha Beach, with any significant support in establishing the beachhead. The eminent Max Hastings, in his outstanding book *Overlord*, opines that air power was “unable to inflict significant damage upon German defensive positions to offer the Allied armies anywhere an easy passage...”<sup>1</sup> Similarly, Adrian Lewis agrees: “To this list of battles with disappointing applications of strategic air power at the tactical level of war can be added the Normandy Invasion.”<sup>2</sup> However, in light of both a detailed examination of what was asked of the American air forces by the OVERLORD plans, and in consideration of modern ideas about effects based operations, it is perhaps time to re-examine the role played by the Army Air Forces in the success of that critical day of 6 June 1944.

“‘Where’, I yelled to no one in particular, ‘is the damned Air Corps?’” was the common refrain among those who participated in the landings at Normandy, particularly on Omaha Beach.<sup>3</sup> This question was most likely based upon a deep misunderstanding by the average soldier of what the air campaign was likely to contribute to the invasion, in large part due to the promises they had been given from the very top. In particular, General Omar Bradley was frequently quoted that the bombardment by air and naval forces was to be lengthy, and that it would essentially punch a hole in the Atlantic Wall fortifications that the Germans had so diligently constructed.<sup>4</sup> Maj Sidney Bingham noted that during Gen Bradley’s late May visit to the 29<sup>th</sup> Division, he told the troops: “You men should consider yourselves lucky and are to be congratulated. You have ring-side seats at the Greatest Show on Earth.”<sup>5</sup> This unchecked optimism regarding the plan for support of the landing was unrealistic given the timeline planned to accomplish the invasion and does not appear to be congruent with the plan as prepared and executed.

The Operation OVERLORD outline plan, dated 24 May 1944 covered the entire invasion in great detail, examining the role to be played by land, naval and air forces in accomplishing a successful landing. In the discussion of the timing of the assault, the plan noted that “From the army point of view...it is preferable that the main assault should take place just before civil twilight in order to obtain darkness in the approach and daylight for the capture of the beach and exploitation.”<sup>6</sup> Of special note in this discussion of the timings in the plan, the optimum conditions for air forces are not discussed beyond those necessary for the delivery of airborne forces.<sup>7</sup> However, the plan did demonstrate a powerful recognition of the strategic role airpower must play for the invasion to succeed.

In July 1943, the War Department published Field Manual 100-20, *Command and Employment of Air Power*. This document defined the use of air forces with a “Doctrine of Employment” that stated “Air superiority is the requirement for success of any major land operation.”<sup>8</sup> Working from this foundation, air forces were assigned the basic tasks of destruction of hostile air forces, denial and destruction of hostile enemy bases of operation, operations against enemy forces, offensive operations against enemy sources of strength, operations as part of task forces, and operations in lieu of, or in conjunction with, naval forces.<sup>9</sup> It then defined the role of strategic and tactical air forces in combat operations. In examining OVERLORD, it is essential to review the missions of tactical air forces in particular, as the support to be provided would be in and around the Normandy area where ground forces were operating.

FM 100-20 assigned three primary tasks to tactical air forces, the highest priority of which was to obtain air superiority, second to prevent movement of hostile troops and supplies into the area of operations, and third to participate in combined operations with ground troops.<sup>10</sup> Each of these tasks are most readily understood in terms of the ultimate effect to be accomplished using airpower versus being true tactical tasks in the traditional military sense. However, the modern concept of measuring effects was not generally well understood at the time, as assessment was still in its infancy. These three tasks, or more accurately, effects to be achieved through airpower, provided the framework under which the allied planners would operate in devising a role for air forces in the invasion of Europe.

In reviewing the “Major Conditions Affecting the Success of the Operation,” it noted that German fighter strength is the top priority for allied planners to be concerned about.<sup>11</sup> “[t]he battle for the [sic] lodgement area will be won or lost in the first few days...This condition [air supremacy], above all others, will dictate whether the amphibious assault can or cannot be successfully launched on any given date.”<sup>12</sup> It is important to note that not only was this listed as essential to success, it was given priority of place ahead of both the attack on German land forces and the role of surprise.<sup>13</sup> Given this recognition then, what did the allied air forces intend to do to achieve this supremacy over the German air forces prior to D-Day?

Allied planners assumed a marked superiority in bomber forces over the Luftwaffe, but in late 1943 and early 1944, enemy fighter forces remained an open question.<sup>14</sup> During the planning cycle, the allies had noted a “definite and steady increase in the first line strength of the GERMAN fighter force,” but projected allied numerical superiority at the time of the invasion.<sup>15</sup> Despite this expected numerical superiority, the planners took into account that the allied fighter forces, particularly in the early days following the invasion, would be working at a significant tactical disadvantage to the German forces because the allies would be flying from bases in England while the Luftwaffe operated from established bases on the continent.<sup>16</sup> In order to counter this, the plan directed allied air forces to prosecute efforts to severely degrade the German air forces prior to the assault phase.<sup>17</sup> While the plan sought primarily to limit the effectiveness of the forces in the Caen area prior to the invasion, it designated an effect as the primary goal, explicitly stating that “an overall reduction in the strength of the GERMAN fighter force between now and the time of the surface assault is essential.”<sup>18</sup>

The allied planners defined four major ways to attack the German Air Force prior to the invasion kickoff. These were given as:<sup>19</sup>

1. Casualties from air battles initiated when allies had the advantage
2. Long term bomber offensive against supply, industry and front line units

3. Disorganization of fighter units and attacks on airfield in fighter range of the Caen area
4. Disorganize and disrupt fighter command and control elements in the Caen area

The long-term, deep-strike efforts against German industry had been the heart of Army Air Force strategic operations throughout 1943 and into early 1944. The remaining tasks, however, would require significant changes in both operation and organization. To accomplish this, General Dwight D. Eisenhower, Supreme Commander of the Allied Expeditionary Force, directed General Carl A. Spaatz, commander of US Strategic Air Forces in Europe and Royal Air Force Chief Marshal Sir Arthur Tedder to place the allied air forces under his direct control in order to best be able to support the invasion. While both Spaatz and Air Marshal Arthur T. Harris, commander of Bomber Command, vocally opposed subordinating their strategic assets to someone other than an airman, this step allowed Eisenhower more direction over the role that the air forces would play in supporting the landings. In the end, this decision proved to be critical to insuring not only the achievement of the required air supremacy, but on the tasks the land forces would require on D-Day.

In his new study, *Omaha Beach: D-Day, June 6, 1944*, Joseph Balkoski notes that General Omar Bradley, the senior U.S. ground force commander, had discussed the role of air forces at the first OVERLORD planning conference in December of 1943, promising that: “The attack will be preceded by a bombing which may last up to six hours. In other words, the present plan is that every bomber in Great Britain will be used in this operation....This area will be drenched by heavy bombers and everything they can throw in it....They are going to use big stuff, including blockbusters. [This] may have some effect on the morale of the [Germans] around there.”<sup>20</sup> In devising the order of battle, as well as the tactical details of the invasion, the planners performed a careful evaluation of the enemy land resistance most likely to be encountered by the assault forces, paying particular attention to the fortifications near areas where landings were possible.

German Minister of Armaments Albert Speer noted that the Atlantic Wall defenses used over 17 million cubic yards of concrete and more than 1.2 million metric tons of iron, and it was clear to the allied planners that

they would both possess formidable firepower and be nearly invulnerable to bombardment.<sup>21</sup> In the OVERLORD plan, the planners sought to engage these beach defenses where they were weakest.<sup>22</sup> This area had been identified as the area between Carentan and the River Dives in the Caen region.<sup>23</sup>

Intelligence reports indicated that the Caen area was “exceptionally weak in coastal artillery” and that the beach defenses were of the “normal types, but are much less strong than those in other sectors where the GERMANS consider a landing more likely; except in regard to mines which have been laid in large numbers.”<sup>24</sup> In assaulting these defenses, the allied planners sought to balance the need for surprise against the likelihood of achieving significant damage through naval fires and aerial bombardment.<sup>25</sup> To accomplish this, the plan directed that preliminary bombardment be “confined to the shortest possible duration consistent with the achievement of the required degree of neutralization.”<sup>26</sup>

In practice, this turned out to be not merely less than the six hours Gen Bradley had initially hoped for, but limited to roughly 15 minutes. Ultimately, the role of the air and sea bombardment of beach defenses on the success of the invasion was downplayed in the plan because they “...cannot be relied on to achieve the permanent neutralization of coast [sic] defence guns, this task can only be achieved by assault.”<sup>27</sup> Thus, it is clear that despite a great many public statements to the contrary, that actual destruction of beach defenses by airpower was not a primary expectation upon which the success of the landings would depend. However, the Allies did recognize the effect that bombardment could have on morale, both friendly and enemy, and thus they pressed forward with the strategic bombing, expecting to achieve at least a temporary shock effect prior to the troops actually hitting the beach. Finally, in examining air action in support of the assault, the necessity of performing interdiction is identified, and was expanded upon later in the plan.

The final duty, in the context of FM 100-20, is provided in detail in the OVERLORD plan under the heading “Action Against Vital Points in Enemy Road and Rail Communications”<sup>28</sup> The planners recognized the importance of delaying resupply and reinforcement of the German units near the beachhead in the days after the invasion would be essential to maintaining the foothold on the continent. As such, air forces would play a

major role in the effort to prevent a German buildup that could overwhelm the allied forces and throw them back into the sea. The plan noted the importance of this role, as given in FM 100-20, but made a caveat that such actions must not give away the element of surprise as to where the landings would take place.<sup>29</sup> The initial plan called for limiting attacks to the Pas de Calais and Seine areas; however it is important to note that the planners in these early stages did not take into account the effect that a broad attack against overall nodes in the French transportation system could have. This kernel of an idea, through the help of Eisenhower and his staff, grew into the Transportation Plan and would have a major impact on German freedom of movement in the Normandy theater of operations.

Clearly, the overall Normandy plan was pessimistic about the value of airpower to the overall plan, except in the case of operations against air units, which it deemed essential to success. However, it is also abundantly clear that airpower was to play a major role in the success of the OVERLORD operation. The failure to appreciate the inherent speed and flexibility of airpower seems to permeate the plan, as it repeatedly noted that air campaigns in the region of the landings could jeopardize surprise. However, given those limitations, the guidelines as given are generally consistent with the FM 100-20 doctrine for the use of airpower. The success of the operation would fall to the airmen as they translated their broad doctrine and the invasion's prerequisites for success into the specific guidance and taskings that make up the OVERLORD Air Plans document.

The importance of complete dominance over the Luftwaffe was best captured in an anecdote in Stephen Ambrose's seminal work: *D-Day, June 6, 1944: The Climactic Battle of World War II*. Recounting a conversation between 2nd Lt John Eisenhower and Gen Dwight Eisenhower on the beachhead at roughly D+7, John was heard to have said of the bumper-to-bumper vehicle congestion on the beach: "You'd never get away with this if you didn't have air supremacy," to which the Supreme Allied Commander responded with a snort: "If I didn't have air supremacy, I wouldn't be here."<sup>30</sup>

The OVERLORD Air Plans document established nine Air Force Tasks for air forces participating in the support of the landings; however, the three primary tasks are given both in charts included with the plan and the text in priority order:<sup>31</sup>

1. Establish and maintain air superiority
2. Interdiction of enemy transportation
3. Support in assault area

These tasks were almost verbatim to those described by FM 100-20. As noted previously, allied air forces had lost their independence to prosecute a purely strategic war against the German homeland by being placed under direct control of the Supreme Allied Commander to support OVERLORD operations. Despite this limitation, the airmen built a plan that was entirely consistent with their doctrine recognizing them as co-equal forces, focusing most heavily on the two primary roles that could be accomplished using the underlying strategic approach to provide the desired effect. Thus they were able to both act in concert with their doctrine of strategic bombardment (for the most part) and be responsive to the needs of the Supreme Allied Commander.

Long before an invasion of the continent was even possible, the assault on the German Air Force had been long underway as a part of Operation POINTBLANK, the Combined Bomber Offensive, with deep attacks against the heart of German industry. This strategic air plan specifically noted that air superiority would depend on attacking "...airframe and engine plants, its ball-bearing plants..."<sup>32</sup> The thinking was that destruction of these targets would have the effect of crippling the Luftwaffe by neutralizing the industrial capacity required to build aircraft. By doctrine and by definition, strategic industrial plant targets were the primary focus of the Combined Bomber Offensive that the Eighth Air Force and Bomber Command had been prosecuting with great vigor over the previous two years.<sup>33</sup>

In reading the OVERLORD Air Plan, task one, as discussed above, is given as "[destruction of t]he German Air Force in its airframe and engine plants, its ball bearing plants, in the air and on the ground."<sup>34</sup> The specific identification of these strategic targets, particularly the focus on industrial capability, is consistent with the critical vulnerabilities that had been identified as central to Luftwaffe strength. However, it was generally believed among the non-Air Force leadership that the strategic effects of these operations, although substantial, were too long term in nature to be sufficient to support the OVERLORD plan. The Germans had

demonstrated a remarkable ability to reconstitute their industry under the hand of the exceptionally talented Albert Speer.

In response, as more and more long-range escort fighters became available in theater, the allies sought to widen the war of attrition against the Luftwaffe to the air as well. In early 1944, Lt Gen James H. "Jimmy," Doolittle, Commander of the Eighth Air Force, directed a change in the mission of his fighters from "The first duty of the Eighth Air Force Fighters is to bring the bombers back alive" to "The first duty of the Eighth Air Force Fighters is to destroy German fighters."<sup>35</sup> Doolittle ordered the fighters to "...still provide a reasonable escort to the bombers, but the bulk of the fighters will go out hunting ...Flush them out in the air and beat them up on the ground."<sup>36</sup> As the landings grew closer, the Air Corps Air Staff Intelligence Analysis division assessed the state of the German Air Force as of late March of 1944.

In the *Status of Air Prerequisites for Operation OVERLORD*, the European Branch of the Air Corps Intelligence Division sought to provide the allied planners with a detailed accounting of the current state of air preparations for the invasion. This report included the Combined Bomber Offensive effects in considering the state of the German Air Force, transportation, ball bearings, oil, rubber and tires, and submarines, as well as general industry, and the attacks on the vengeance weapons. The analysts estimated that by the time of the landings that roughly 77 percent of the German's Western Front fighter force (880 aircraft) would be held back in the Low Countries and northwest Germany to defend against the bombers, rather than in France near Caen, meeting the required level to prosecute the landings.<sup>37</sup> In addition, the study examined overall German fighter strength at approximately 2,125 fighters, using Air Ministry estimates as of 1 June 1943 as the basis of comparison.<sup>38</sup> Based upon the then current rate of attrition, referred to in the document as wastage, and the success of the bomber campaign against reserves and production, the staff concluded that overall strength in available fighters to resist an invasion in mid-1944 would be less than that of June 1943.<sup>39</sup> Of the highest importance to this analysis, was the fact that casualty figures in January 1944 demonstrated wastage greater than production for the first time in several months.<sup>40</sup> The analysts went on to assess the overall state of the war on the Eastern Front, and concluded that Soviet progress against German forces was better than initially estimated, and thus the

Luftwaffe would likely be unable to shift forces from east to west. It is especially interesting to note that this report did not consider the readiness or skill of the pilots likely to man these aircraft, which, as will be discussed, had been in a steep decline. While this effect would have been difficult, if not impossible for the allies to know with any surety, it was to have a dramatic effect on the final outcome of achieving air supremacy over the continent.

In the end, the staff concluded that with the exception of two minor assumptions, the ability to keep German aircraft employed in Italy out of the OVERLORD area, and the sheer number of airfields in range of the Caen area, the air prerequisites for OVERLORD had been achieved.<sup>41</sup> Air supremacy seemed assured; however, this was merely the first step for the landings. Next, air forces would need to be able to support allied forces after the landings by creating conditions such that German reinforcement through France would become all but impossible.

The goal of Eisenhower's Transportation Plan was to systematically deny the German Army forces the use of the extensive French rail system using pre-emptive interdiction. The brainchild of Professor Solly Zuckerman, the Transportation Plan, Eisenhower was convinced, would be the cornerstone to maintaining an allied foothold on the continent as the enemy sought to move reserves into the landing area.<sup>42</sup> Zuckerman made the case that the railway network resembled a nervous system, and sufficient damage to key nodes would bring down the entire network—a basic tenet of effects based operations.<sup>43</sup> Allied intelligence indicated that the German Army planned to keep significant forces in reserve in rear areas of France to be deployed forward against the allies once it became clear where the main thrust of the invasion was located. In preparing the plan, Eisenhower encountered stiff resistance from the British, including Prime Minister Churchill. Churchill was concerned about the long term political implications of potentially significant numbers of French casualties resulting from errant bombs and inadvertent attacks on civilian rail transportation. In addition early discussions on the merits of the Transportation Plan were vehemently contested by both Spaatz and Harris. Both felt the proposed targets were unsuitable for attack by heavy bombers either day or night, and framed their argument as a technical mismatch between forces and target type, and expressed deep concerns over the level of accuracy required.<sup>44</sup>

Spaatz felt that the attacks against the railway network were a tactical interdiction mission that worked at cross-purposes to the overall strategic plan he had been tasked to accomplish. At the time, he was in the midst of his campaign against the German aircraft industry, and he went straight to the General H. H. "Hap" Arnold in Washington, asking him to press the issue with Gen Eisenhower.<sup>45</sup> As a result, the heavy bombers received a month-long respite from railway targets to fly against strategic aircraft industry targets in Germany and further cement air supremacy over the beachhead.<sup>46</sup> During this month, Spaatz continued to argue for full independence of the strategic assets versus ceding tactical control to Eisenhower for the invasion. In particular, Spaatz wanted permission to further expand his attacks against the German oil industry that he had begun during POINTBLANK. However, Allied leadership ultimately rejected this approach as requiring too long to actually impact the German front-line forces.<sup>47</sup> In addition, there was a significant disagreement as to whether the French railway network could be sufficiently degraded in capability to delay the German reserve forces in any meaningful way because of the density and level of redundancy inherent in the railroads in that region.<sup>48</sup> This highlights a common concern among EBO critics regarding assessment and the ability to predict the level of destruction of a target set required to achieve the desired outcome.

In early March, 1944, Air Chief Marshal, Sir Trafford, Leigh-Mallory's Bombing Committee submitted a request for an initial 75 railway targets, in an attempt to demonstrate that a successful strategic attack would sufficiently degrade the railway network to enable tactical follow-ups after the landing to concentrate on a few remaining corridors.<sup>49</sup> The planned goal was to force the Germans to the roads within a 150 mile radius of the landing areas.<sup>50</sup> This would have the dual effect of causing them to both slow down and increase their consumption of oil and logistical supplies as they pushed towards the battle area. Although some early bombing trials had been accomplished with medium bombers, it was clear to Eisenhower that, the mass provided by heavy bombers would need to be a part of the fight to really make the plan work.

As the invasion grew closer, it became increasingly urgent that the full strength of the Eighth Air Force and Bomber Command be brought to bear against the German-controlled French transportation network. As a test case, on the night of 6/7 March, 1944, Bomber Command launched a

major attack against the Trappes railway center, southwest of Paris. The attack was a great success as the depot, locomotives and rolling stock were so badly damaged that repairs took over a month to complete.<sup>51</sup> With this resounding success in hand, the advocates for the Transportation Plan met with the Defence Committee in early April to seek Churchill's approval to press forward on a wide front. The plan was approved with the caveat that targets be restricted to those likely to limit French civilian casualties. While early results showed the ability of the Germans to quickly affect repairs, the hope was that continued attacks against a wide front would reduce their capacity and efficiency over time.<sup>52</sup>

As the heavy bombers began attacks against the railroads, Churchill continued to express his concerns about the plan to both Eisenhower and President Roosevelt.<sup>53</sup> Eisenhower had full faith in the effort, and responded eloquently back to the Prime Minister by letter where he stated:

“Casualties to civilian personnel are inherent in any Plan for the full use of airpower to prepare for our Assault....the Overlord concept was based on the assumption that our overwhelming air power would be able to prepare the way for the Assault. If its hands are to be tied, as is now suggested, the perils of an already hazardous undertaking will be greatly enhanced.”<sup>54</sup>

Roosevelt, in turn noted that the matter should be left in the hands of “the responsible Military Commanders,” and from that point forward, further debate on the Transportation Plan stopped, with Churchill fully supporting Eisenhower, with the underlying understanding that every effort to minimize civilian casualties would be taken.<sup>55</sup>

Of the three essential tasks given to the allied air forces, the one of most concern among the landing troops was direct attacks against the German forces and fortifications arrayed against them on the beaches. As previously noted, Gen Bradley had spoken widely about the “Greatest Show on Earth” in reference to the air and sea attacks that would directly precede the landings of troops on the beach. The overall plan for the air support on the beach went through a great many iterations prior to the final lockdown in late May of 1944.

Army leadership and ground troops widely believed that there would be a significant heavy bomber attack, coordinated with a withering naval artillery barrage on the beaches of Normandy. In particular, it was expected that the full force of the heavy bombers of the Eighth Air Force would so pummel Omaha Beach that the troops would meet only light resistance when they landed. However, as the plan developed, significant restrictions were placed upon the air forces that would make the task extraordinarily difficult, if not impossible. First and foremost, summer weather in this region was highly unpredictable, with heavy cloud cover that averaged one day out of every three, making the precision bombing necessary to damage heavy fortifications nearly impossible.<sup>56</sup>

As part of the planning process for OVERLORD, Gen Hap Arnold tasked a study to devise tactical measures to destroy and/or neutralize emplaced coastal guns in support of amphibious landings.<sup>57</sup> Maj Gen Laurence Kuter, Assistant Chief of Plans for the Air Staff, drew upon a late December 1943 assessment done by the Army Air Forces Board that studied prior combat experience, particularly that of US forces in Corregidor in the Pacific Theatre as well as Pantelleria in the Mediterranean. The study noted that the guns of Fort Drum:

sustained over 1,000 hits from armor piercing shells during one day without being put out of action. Her guns were firing up to the moment of surrender of Corregidor. Pantelleria was hit with one of the greatest concentrations of bombs ever released on a single small objective. Yet the great majority of her coastal defense guns were still in commission and able to fire at the invading forces if the defenders so desired.<sup>58</sup>

It went on to note that modern fortifications had been successfully reduced by “elimination of observation stations...followed by combat engineers with the necessary explosive charges” or by “Direct attack by airborne troops.”<sup>59</sup> Ultimately, this letter concluded that “Modern [sic] implanted fortifications manned by determined defenders cannot be put out of action by aerial attacks with demolition bombs.”<sup>60</sup> It further concluded that the fortifications could be “neutralized”—note here that the focus is on effect, not destruction—by the use of “great quantities of smoke” [emphasis in original].<sup>61</sup> Based upon this prior experience, General Kuter concluded in

paragraph five of the cover letter that “Experience with concentrated air attack against well constructed coastal gun positions is not encouraging...Every resource, air attack, airborne troops, smoke, heavy naval gunfire, should be coordinated into the plan.”<sup>62</sup> Concluding that insufficient paratroops would be available to neutralize the guns once the initial drops near Caen and Carentan were completed, it states that

“The air bombing attack by OBOE methods [night bombing by radar on the night of D-1] is worth trying, but should not be relied upon for more than severe harassing effect.”<sup>63</sup>

Thus, it is clear that it was reasonably well understood in some circles of the United States Army Air Forces that focused attacks against well emplaced guns would likely have minimal direct effect, but may well have a significant harassing effect. The psychological effect of bombing upon troops remains one of the most debated topics in airpower studies. The skeptics claim that reduced morale and decreased military efficiency are simply the cover that airpower advocates turn to when the military utility of an operation cannot be discerned. While there is certainly some validity to this argument, the other side presents compelling evidence as well. In speaking of the Combined Bomber Offensive attack against Hamburg, Albert Speer famously noted that only a few more campaigns as focused and devastating as that one could have driven Germany out of the war. The US Strategic Bombing Survey devoted an entire volume to the role of bombing on civilian morale, and the evidence suggested that bombing could have significant effects on a population. However, these examples reflect the impact of bombing upon a civilian population, not that of what was believed to be an experienced, well-disciplined German Army moving to defend and reinforce the Atlantic Wall in what amounted to a life-or-death operation for the *Wehrmacht*. It is essential to note that the allies did not need to reduce the German beach defenses to rubble to succeed, only degrade them sufficiently to establish a strong enough position that they would not be thrown back into the sea.

With Eisenhower and Bradley determined to maximize the number of troops they could put ashore during daylight hours, the window for launching an air attack continued to shrink. With H-hour designated to occur at 0630, shortly after civil twilight, the bombers were allocated only

15 minutes prior to the first landings to be over the beach and release their payloads. The plan for Omaha specified a high-altitude, precision bombing attack with the Eighth Air Force's heavy bombers streaming in perpendicular to the beach at over 15,000 feet, while the plan for Utah utilized the medium bombers of the Ninth Air Force flying in a parallel path over the beach at 4,000 to 6,000 feet. From a space perspective, the timeline for the bombing of Omaha Beach required the Eighth Air Force to "drench" the beach with fire while the landing craft were a mere 3,000 feet from the bomb line.<sup>64</sup> Utah required a different approach because the chance of friendly fire incidents was even higher as airborne troops were already inland prior to the landings and the risk of bombs falling long and hitting American soldiers was deemed too high to attempt the perpendicular approach.<sup>65</sup> The attack on the beaches was to coincide with heavy bombardment from the sea from battleships sporting fifteen inch guns, as well as rocket salvos from specially constructed rocket ships. At a February 1944 OVERLORD conference, the US Army V Corps summary predicted the effect of the combined fire plan: "Every house and other building with observation over the beach will be knocked out. Also, all possible pillboxes."<sup>66</sup> Despite these statements by the ground generals, the air forces were hampered from their best effectiveness by the restrictions placed on the bomber loadouts.

As First Army Commander, General Bradley had the ultimate responsibility for the American portions of the operation, namely the landings on Utah and Omaha beaches, placed squarely upon his shoulders. Thus he may be forgiven if some of the decisions he made appear foolish in hindsight. Of special significance to the success of the air mission is the effect sought by the supported ground commander. Brig Gen Smith, Chief of Operations for the Allied Expeditionary Air Force noted that: "I explained to [army commanders] that the effect which each commander wanted on his particular beach was his prerogative. He could tell us what effect he wanted; if it were anti-personnel, and cutting above-ground communications—tell us that...We would prescribe the bomb load to achieve that."<sup>67</sup>

Given this flexibility, and knowing the heavy construction of the German defenses, one would expect the Army to specify bomb loads to concentrate on heavy, penetrating projectiles to maximize the damage to the fortifications. Added advantages to this type of bomb load would be beach

cratering, which would provide cover for advancing ground troops moving up an exposed beach, as well as destruction of German obstacles on the beach should such bombs miss their target. But Bradley, focused primarily on the long-term need to rapidly bring significant mechanized and armored forces ashore to maintain and expand the beachhead, insisted that the cratering of Omaha Beach be kept to a minimum.<sup>68</sup> To satisfy this requirement, the majority of the bomb loads to be used against Omaha would consist of 100 pound bombs with instantaneous fuses. Among the lightest weapons in the Eighth's inventory, they were highly effective against personnel and light obstacles, but virtually useless against concrete fortifications.<sup>69</sup> Thus, the Eighth went into action against targets that would be extremely difficult to hit under the best conditions, close to friendly troops, in weather that would likely be poor, using weapons that would have almost no effect against the target they were to hit. Even the most casual observer can conclude that this was a virtual recipe for complete mission failure. However, it is essential to review what effects allied air forces sought to accomplish with air actions against the beach.

Intelligence reports indicated that the Germans were expecting the landings to occur in the Pas de Calais region. To reinforce this ruse, bombings were made outside the main landing area at Normandy at a rate of two to one.<sup>70</sup> In addition, reconnaissance had revealed that the Normandy beaches had the weakest defenses of all the possible landing beaches in France. Also as discussed, the time allocated to allied bombardment prior to the landing had shrunk from six hours to a mere fifteen minutes in length between Bradley's initial December 1943 plan and D-Day. Finally, the heavy bombers were being asked to perform a mission for which they had not trained: close-in support to ground troops. Given these facts, it seems clear that the role of the heavy bombers in this final tasking for the landings could at best be psychological. With that assumption in place, the effects on the German Air Force, interdiction of enemy transportation assets, and beach support must be examined to determine whether the Eighth Air Force's OVERLORD contribution was of any value.

The success of the Eighth Air Force and Bomber Command against the German Air Force had been a topic of great debate and study since the start of the Combined Bomber Offensive. The Combined Bomber Offensive, or Operation POINTBLANK, had pressed the effort against

German industry since early 1943. But the focus on the aircraft industry in particular, Operation ARGUMENT, began with attacks on the aircraft plants in Leipzig, Gotha and Brunswick in February 1944.<sup>71</sup> Thus began Big Week.

During Big Week, the allies generated nearly 6,200 bombing sorties, dropping over 19,200 tons of bombs on eighteen airframe and two ball bearing manufacturing centers at the loss of 370 bombers, 38 fighters and over 5,000 men.<sup>72</sup> Despite this horrific level of attrition, allied fighter wings finished Big Week with 90 percent more P-51s than they had begun with.<sup>73</sup> The Luftwaffe, however, lost over one-third of its authorized strength, which given the attacks against the industrial capacity, and the resultant degraded ability to reconstitute, were devastating.<sup>74</sup> Even more alarming for the Luftwaffe was the loss of experienced pilots. During the period of January to May 1944, the time of most critical need prior to OVERLORD, the German Air Force lost the equivalent of its entire fighter pilot strength.<sup>75</sup> This meant that the Luftwaffe was unable to expand to meet the growing threat as allied fighters became more numerous and penetrated more deeply into Reich airspace.<sup>76</sup> While the Combined Bomber Offensive and the deep strike attacks were the heart of the effort against the Luftwaffe, the long-term impact that escort fighters played in the campaign is beyond dispute. The change in tactics in January 1944, when Gen Doolittle freed the fighters to go on the offensive, doomed the German Air Force and made the OVERLORD landings possible.

While Big Week and follow-on efforts significantly degraded Germany's aircraft production, dispersing what it did not destroy outright, air supremacy had not yet been fully realized as the Luftwaffe continued to rise to combat the allied bombers and fighters. This drove the Americans to attack prestige targets in daylight in an effort to lure the Germans into air-to-air combat in the hopes of winning the attrition war.<sup>77</sup> The Battle of Berlin is a classic example of this strategy. Taking heavy daylight bombing to the German capital forced the Luftwaffe into a maximum effort response against the bombers and their long range escort fighters, at the cost of nearly 120 German fighters in two days.<sup>78</sup> Following Doolittle's direction, the allies increasingly attacked German airfields and training facilities on the return trips out of Germany, strafing airfields with relative impunity.<sup>79</sup> With POINTBLANK operations still ongoing, the

Germans were hard pressed to replace lost pilots due to a lack of flyable training aircraft, and more importantly, major constraints on petroleum, limiting training hours to the barest minimum.<sup>80</sup> Additional attacks were made against command and control elements and radar stations, but by this time, there were few assets left to control in the French area of operations; at the time of the Normandy landings, the Luftwaffe had lost 3,278 aircraft, translating to a 78 percent decline in strength.<sup>81</sup> The Luftwaffe managed less than 100 sorties against the beachheads by the afternoon of 6 June, mostly by single engine fighters, with an additional 175 sorties after night fell, with naught effect but harassment.<sup>82</sup> The allies had landed on French soil with complete air supremacy. Maintaining and expanding the beach head would require that airpower ensure the German reinforcements would either not make it to the front, or arrive late and depleted.

By the end of May, having endured nearly two months of full-scale attacks by heavy bombers, the level of railway traffic operating in northwestern France had appreciably decreased from over 50,000 loaded wagons per week to roughly 10,000.<sup>83</sup> In the final two weeks prior to the landing, the focus of the bombing changed somewhat from the railways to make the Germans believe that an attack was coming shortly in the Pas de Calais region.<sup>84</sup> While this took some of the pressure off of the railroads, the final attacks against the most critical nodes of the transportation network prior to this diversion left the French railways in a virtual shambles. Allied assessments concluded that of the initial 80 targets, 51 were damaged so badly that further attacks would have no effect, 25 still required attacks against key installations and only four needed significant attention.<sup>85</sup> Because the level of destruction led the intelligence community to believe that the majority of traffic still running would be of a military nature, all previous restrictions on attacking trains in operation was removed.<sup>86</sup> By the time of the landings, the French railway system had all but collapsed, and the French Resistance forces organized sabotage operations throughout the countryside to maintain this level of system paralysis.<sup>87</sup>

The combined effect of the Transportation Plan and the total air superiority over France was dramatic. The Germans lost all freedom of movement during daytime due to harassment of allied fighters returning from escort duty or simply performing fighter sweeps. In an article written on the loss of German air supremacy, Dr. Rich Muller notes one Luftwaffe

officer report that "enemy air activity rendered all daytime convoy traffic impossible with the exception of fully armored units."<sup>88</sup> He goes on to note that an increased reliance on radio traffic combined with British knowledge of the Enigma secret made any coordinated movement of Luftwaffe units into France exceedingly challenging.<sup>89</sup> In his excellent book on Pete Quesada, Thomas Hughes recounts the journey of the German 266th Division and the 353rd Division. The 266th left Brittany, advanced less than ten miles per day and did not reach the front for fifteen days, while the 353rd left Brittany on 14 June, arriving on the 30th, a rate slower than a typical American Civil War march!<sup>90</sup> Having met the first two goals of achieving air supremacy and interdiction, the final primary role of the allied air forces was to provide direct support in the assault area.

The story of direct air support to the landing beaches is held by a great many historians as a fiasco that created a bill paid for in blood by the soldiers who landed on the beach, and in great numbers, died there. This pays a great disservice to the airmen who had already paid their price in the skies over Europe in the months leading up to the landings with 5,427 killed with an additional 1,943 wounded and 11,033 missing in the January through May of 1944 period leading up to the invasion.<sup>91</sup> The success of the operations must be judged in light of the tasking given to the air forces and whether they achieved their aims.

It is inarguable that the air forces earned complete air superiority over the landing beaches as the troops landed free of all but minor harassment from the Luftwaffe. In terms of logistics, the Germans were unable to marshal sufficient reserve forces to make a move against the beachhead, being forced to resort to a defense in depth. Thus, the transportation and interdiction campaign plan was wholly successful. However, the story of direct support to the beaches must be told in two parts, one for Omaha Beach, which used heavy bombers at high altitudes flying over the landing forces, perpendicular to the beach, and one for Utah Beach, using medium bombers, at low altitude, flying parallel to the beach. Given these different approaches, the effects achieved were dramatically different and deserve examination as to effectiveness, plans and approach.

The landing at Omaha beach was one of the most difficult assaults of the entire OVERLORD operation. The beach itself varied dramatically in

depth, ranging from as long as 500 yards at low tide to a mere 100 yards at high tide rising up to a four to six foot high seawall and rock covered shingle. Beyond the seawall lay German barbed wire and obstructions among swamp and heavily tangled undergrowth, with a forested 100 foot high plateau backing up to the beach. The plateau oversees five draws, or valleys, through which the invading forces would have to pass to go inland. The Germans took advantage of this highly defensible beach, building large fortifications and pillboxes that offered withering enfilade fire support that was virtually invisible from the sea. Though the allies had performed significant aerial reconnaissance of the area, and were aware of these defensive positions, it was virtually impossible to attack many of them with naval bombardment, as it was impossible to sight them and adjust fire. It was hoped that the air attack would significantly reduce their ability to respond against the allied troops as they came ashore.

RAF Bomber Command, under Operation FLASHLAMP made a night bombing attack on ten of the coastal batteries, seeking to drive the gun crews into their shelters and disrupt operations while the assault teams loaded into the smaller landing boats.<sup>92</sup> Over 1,100 RAF heavy bombers took off late on the night of 5/6 June in order to complete their operations close to the start of the naval bombardment and the American day bombing attack. The timing was devised to maximize continuity and give the Germans minimal time to return to their posts and mount an effective attack.<sup>93</sup> The RAF dropped over 5,900 tons of bombs on their targets, mostly of the 1,000 and 500 lb types.<sup>94</sup> The effects, as assessed shortly after the landing by allied experts, found that the "Physical damage to guns and casemates does not appear to have been very extensive even when hits were registered near the guns."<sup>95</sup> However, damage to nearby buildings and other installations appeared to have impacted the efficiency of the gun crews.<sup>96</sup> Of special note was that information obtained from prisoners and a captured German report indicated that "[German] personnel suffered so badly from shock that while most of them were disinclined to come out of their shelters; many were incapable of efficient work even when they did man the batteries."<sup>97</sup> As the RAF night bombers withdrew under the approaching dawn, the Liberators of the Eighth pressed their attack against the beach.

As previously discussed, the plan for air attack on the beaches had shrunk from the six hours Bradley had bragged of to the time between the end of

naval bombardment and troops actually landing on the shore. The bomber crews had been given their orders just before midnight on 5 June. They were to attack 13 targets on Omaha, each with 36 Liberators carrying 52 100 lb bombs with instantaneous fuses to minimize cratering of the beach.<sup>98</sup> The attack used a perpendicular approach into the beach, and as a result, the target area would be the extremely narrow beach area and the individual fortifications sited on the plateau overlooking the beach. While this approach minimized the time that the bombers would likely be subjected to German flak, it made the target area extremely small, and misses would either be short and hit the landing troops, or long, well inland of the invasion zone. The bombers would have to take off in the dark and fly a racetrack course over England during the assembly period to allow all of the planes to get airborne and into formation prior to heading east to the French coast. Unlike the RAF bombers, the Eighth was first and foremost a day bomber force, and the night assembly proved a major test to the crews, particularly in the poor weather over England that morning. The crews rose to the occasion, surviving the precarious task of a night assembly with the loss of only one B-24, the crew of ten the first casualties of the Omaha Beach operation, and the bombers at last flew east towards the attack area.<sup>99</sup>

The timing of the overall operation was extraordinarily precise given the need to maximize the amphibious landing time on Omaha while the tide was low enough for the landing boats to avoid the German obstacles. The B-24s were given hard guideline to cease attacks in the beach areas five minutes prior to H-Hour, when the troops would actually land.<sup>100</sup> Any bombers making attacks after this time would press inland to alternate targets, well away from the beach. The naval bombardment was to begin at civil twilight, or as soon as spotting was practicable, and would continue for about 40 minutes prior to touchdown. The weather that day was poor, with a total overcast obscuring the view of the Liberators which were flying at an altitude of 15-20,000 feet. As a result, the crews had to result to radar bombing over the beaches.

While radar bombing could put a bomb in the general area of a target, it was far from the “pickle barrel” accuracy that the Norden bombsight could accomplish under favorable conditions. With the primary concern among the airmen and their leaders being the risk of dropping bombs short among the tightly packed landing ships, they had received conservative guidance

for the bombings at Omaha. The crews had been told that friendly troops would be “400 yards to one mile offshore” during the attacks, and thus great care was to be used in making their bomb runs.<sup>101</sup> This was translated into very specific guidance for operations in overcast conditions.

Briefings the morning of the operation directed the bombardiers to delay their drops by five to thirty seconds after the radar return would indicate, depending on the proximity to H-Hour.<sup>102</sup> Later bombers would delay their drops longer to ensure that the Eighth would not be responsible for any fratricide. While this was an entirely logical response to the situation by the airmen, it resulted in no bombs actually falling on Omaha Beach.

The attack on Utah Beach was based on a significantly different concept of operations. Most importantly, the chances of friendly fire were a major consideration in devising the path to be taken by the bombers. Because a large number of airborne troops had been dropped into the Cotentin Peninsula, to disrupt German operations behind the beaches, the risk of bombs falling long posed a significant threat to allied troops inland. Combined with the risk of hitting the landing troops with short bombs, this required a different approach to air support—essentially a true close air support (CAS) operation. Fortunately, the planners had just the asset available to fill the need—the Ninth Air Force and its B-26 Marauders.

The B-26 Marauder was a medium bomber, far smaller than the B-17s and B-24s flown by the Eighth Air Force. Designed by Martin Aircraft, it was not well suited for the long range, high altitude precision daylight bombing around which the Army Air Force had built its entire doctrine. It did, however, excel when working at its design altitude of 10,000 to 12,000 feet.<sup>103</sup> When operated by the crews of the Ninth Air Force, which unlike the Eighth, had been created specifically to support ground forces, and were well trained in the delicate dance of close air support, the Marauder was an exceptional aircraft. The Ninth had been relocated from the Middle East to England to prepare to support the troops after the invasion and allow the Eighth to continue its primary efforts against German industry.<sup>104</sup> At a meeting in October 1943, Lt Gen. Ira C. Eaker put forth his intent when he noted that “The Ninth will be tactical, and the Eighth strategic.”<sup>105</sup> Drawing heavily on experience earned in North Africa, the Ninth took seriously the role of supporting ground forces. Brig

Gen Samuel E. Anderson, commander of the Ninth's bombers on D-Day noted that "Enthusiasm was always highest when the mission was in direct cooperation with ground operations."<sup>106</sup> The Ninth stood up fast and trained hard to perform just this sort of mission. It was with this frame of reference that of a tactical air force, that the Ninth entered D-Day operations.

The Marauders endured the same difficulties of nighttime assembly over England. However, while the heavy bombers were tasked to fly to their targets at altitudes above the cloud cover, the B-26s entered the area of operations at 4,000 to 6,000 feet, with some aircraft claiming to have bombed from well below that.<sup>107</sup> As at Omaha, the aircraft were lightly loaded, carrying bomb loads primarily consisting of 250lb bombs with instantaneous fuses to minimize cratering, although 16 aircraft were loaded with two 2,000 lb bombs for heavily fortified positions.<sup>108</sup> Flying along the coastline of the Cotentin peninsula at such low altitudes, the aircraft were subject to a tremendous amount of ground fire from the time the French coast came in sight. The low altitudes exposed them not only to the usual flak, but smaller caliber ground fire to include machine guns and aimed rifle fire. The lower altitude did give them the advantage of being below the clouds and able to see their targets, and this fact greatly improved the effectiveness of the attacks. Coming in at low altitude, combined with the parallel attack run enabled virtually every bomb dropped on the beach to hit something of value. Post-strike analysis rated the accuracy of the attack as unprecedented. On Utah Beach, 293 Marauders dropped over 4,400 bombs, totaling over 1 million pounds of explosives.<sup>109</sup> Of those bombs, 16 percent were close enough to be considered direct hits, with fifty-nine percent landing within 500 feet of their targets.<sup>110</sup> In addition to the destruction wrought upon the German defenses, the Utah bombings had a significant impact on the morale of the defenders, as told in Ambrose's *D-Day*. Immediately after the bombing, Lt Arthur Jahnke of the German Army, came up from the shelter wounded and surrounded by equipment heavily damaged or destroyed by the bombing. Ambrose notes that Jahnke's men emerged from their shelter "horrified" and ready to surrender at the prospect of facing the invaders with only two machine guns and two grenade launchers after their Flak 88 was damaged and two 75mm cannon, two 50mm anti-tank guns, and

flamethrowers were destroyed.<sup>111</sup> This was the effectiveness of airpower on Utah Beach.

The value of airpower on the beaches on D-Day was a story of contrasts. On Omaha Beach, strategic assets were employed against a target the bombardiers could not see with extraordinarily tight restrictions, under some of the worst possible weather conditions imaginable. Approaching a 500-yard wide target at over 200 miles per hour, bombing by radar through extreme overcast was an impossible task. The heavy bombers tasked to support Omaha were ill suited to the mission and were not flexible enough to adjust to the tactical realities of the operation. Ultimately, they did the job asked of them in the way they had always done it; taking extreme care to ensure they did not cause any fratricide that could have devastated the landing force. Because the aircraft flew so high and the bombs fell so far inland, it is unlikely that the German defenders even knew the bombers were there. Given the technology of the time, as well as the way the Eighth was organized and trained, the bombers did as well as could be expected.

On Utah Beach, the tactical air forces of the Ninth Air Force were perfectly suited to the mission given them. Taking advantage of the geography of the Cotentin Peninsula by making a direct approach south from England, they chose to take a parallel approach along the beach, virtually guaranteeing that every bomb dropped would land on the beach. As a result of this attack plan and the low altitude that kept them below the overcast, as well as operating a platform suited for the task, the Ninth achieved results that are impressive, even by modern standards. When considering the effects of the attack beyond the destruction of the defenses, the results are simply amazing. When the troops landed at Utah, they approached a highly disorganized German Army through smoke and debris thrown up by the attack, and had a far easier time than that of the troops on Omaha. While the air attack does not fully explain the ease of the landing at Utah, it was certainly a contributor.

An effects based operation requires actions to be judged as to how well they achieve an operational result versus a purely tactical measure of success. Joint Publication 3-60 defines effects based targeting as “the ability to identify the targeting options, both lethal and non-lethal to achieve the desired effects that will support the commander’s

objectives.”<sup>112</sup> In looking at the role of the allied air forces in achieving a defensible beachhead on the continent, one need only look at the plan for airpower in the invasion. As previously noted, two of the tasks given to airpower were to achieve air supremacy in the region of the invasion and to interdict enemy forces heading for the invasion area. Both of these requirements had their basis in operations taken prior to the actual landings, and both were successful beyond the planners’ wildest hopes. Thus it is essential to consider airpower’s broad role in the invasion rather than solely dwell upon the actions upon the beaches.

Considering again the question as to the effectiveness of airpower on the OVERLORD landings, it is eminently clear that the allied air forces not only provided effective support to the invasion force, but made the entire endeavor possible. Looking at the effects achieved on D-Day by the Combined Bomber Offensive, the Eighth Air Force not only devastated the German Air Force at the factory and deep in the German heartland, but with the help of long range escorts, attrited the Luftwaffe fighter force in a manner that favored the allies. Having destroyed the German Air Force, the allies then set the conditions to ensure that it would be difficult, if not impossible, for the Germans to reinforce the front and throw the invaders back in the sea through the Transportation Plan. Finally, Air Force operations in direct support of the landing troops on the beach, while not entirely successful, were a major contributor in the ease of landing on one of the five beachheads on D-Day.

As previously noted, an effects based operation requires success be measured against how well the operation achieves an operational result. To accomplish this, modern doctrine seeks to define success in terms of the remaining post-attack effectiveness of some measure of enemy strength or capability. As this research demonstrates, the OVERLORD air planners created a blueprint to support the invasion that did exactly that; focusing on desired outcomes through a discrete campaign with a sublime demonstration of operational art. In achieving air supremacy, the plan did not solely seek to destroy one aspect of the Luftwaffe to the exclusion of all others, such as industry versus airfields versus aircraft in combat, but sought primarily to win control of the air. The Transportation Plan did not aim primarily to destroy French railroads as an end, but instead saw it as a means to cripple German ability to reinforce troops at the front, focusing on primary nodes versus overall destruction of the entire infrastructure.

The attacks on the beaches sought to disable and disorganize the defenses; the airmen, if not the ground leadership, understood the limitations of airpower against heavy fortifications, but made their best possible effort, with admittedly mixed success. The OVERLORD plan was, in the end, an effects-based operation that captured the essence of what modern planners view as the cutting edge in operational art. The question of whether airpower's contribution to the invasion of Europe was effective cannot be answered with anything but a resounding "YES!" Ultimately, the role of airpower to the ultimate success of OVERLORD cannot be understated, even though the direct destruction on D-Day was less than planners hoped.

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## *End Notes*

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<sup>5</sup> Ibid., 72.

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<sup>9</sup> Ibid., 6.

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<sup>11</sup> “Operation ‘OVERLORD’: Appreciation—Parts I, II and III, Outline Plan,” 9.

<sup>12</sup> Ibid.

<sup>13</sup> Ibid., 9-10.

<sup>14</sup> Ibid., 17.

<sup>15</sup> Ibid., 17-18.

<sup>16</sup> Ibid., 18.

<sup>17</sup> Ibid.

<sup>18</sup> Ibid.

<sup>19</sup> Ibid.

<sup>20</sup> Balkoski, *Omaha Beach: D-Day, June 6, 1944*, 72.

<sup>21</sup> Ibid., 38.

<sup>22</sup> “Operation ‘OVERLORD’: Appreciation—Parts I, II and III, Outline Plan,” 16.

<sup>23</sup> Ibid.

<sup>24</sup> Ibid.

<sup>25</sup> Ibid.

<sup>26</sup> Ibid.

<sup>27</sup> Ibid., 17.

<sup>28</sup> Ibid., 24.

<sup>29</sup> Ibid.

<sup>30</sup> Ambrose, *D-Day, June 6, 1944: The Climactic Battle of World War II*, 239.

<sup>31</sup> Assistant Chief of Air Staff-Plans, "OVERLORD Air Plans," 1.

<sup>32</sup> Ibid.

<sup>33</sup> Air Ministry Air Historical Branch, Royal Air Force (UK), "R.A.F. Narrative (First Draft), the Liberation of North West Europe, Vol. III, the Landings in Normandy," 13.

<sup>34</sup> Assistant Chief of Air Staff-Plans, "OVERLORD Air Plans," 1.

<sup>35</sup> R. Cargill Hall, *Case Studies in Strategic Bombardment* (Washington, D.C.: Air Force History and Museum's Program, 1998), 212.

<sup>36</sup> Ibid.

<sup>37</sup> Assistant Chief of Air Staff-Plans, "Status of Air Prerequisites for Operation OVERLORD with Estimation of Situation (Including Effectiveness of CBO)," 2.

<sup>38</sup> Ibid.

<sup>39</sup> Ibid., 3.

<sup>40</sup> Ibid.

<sup>41</sup> Ibid., 1.

<sup>42</sup> Army Air Forces in WWII, V.3 Wesley Frank Craven et al., *The Army Air Forces in World War II*, 7 vols., Vol. III: Europe: ARGUMENT to V-E Day, January 1944 to May 1945 (Washington, D.C.: Office of Air Force History, 1983), 73.

<sup>43</sup> Ibid.

<sup>44</sup> Air Historical Branch, "R.A.F. Narrative (First Draft), the Liberation of North West Europe, Vol. III, the Landings in Normandy," 23.

<sup>45</sup> Craven et al., *The Army Air Forces in World War II*, 75.

<sup>46</sup> Ibid.

<sup>47</sup> Air Historical Branch, "R.A.F. Narrative (First Draft), the Liberation of North West Europe, Vol. III, the Landings in Normandy," 25.

<sup>48</sup> Ibid., 24.

<sup>49</sup> Ibid.

<sup>50</sup> Ibid.

<sup>51</sup> Ibid.

<sup>52</sup> Ibid., 25.

<sup>53</sup> Ibid., 26.

<sup>54</sup> Ibid.

<sup>55</sup> Ibid.

<sup>56</sup> Hastings, *Overlord: D-Day and the Battle for Normandy, 1944*, 266.

<sup>57</sup> Assistant Chief of Air Staff-Plans, "Appreciation of Air Operations against Heavy Coastal Gun Installations in Relation to OVERLORD." Cover Letter 3, pg 1.

<sup>58</sup> Ibid., Cover Letter 3, p. 2.

<sup>59</sup> Ibid.

<sup>60</sup> Ibid.

<sup>61</sup> Ibid.

<sup>62</sup> Ibid., Cover Letter 2.

<sup>63</sup> Ibid.

<sup>64</sup> Balkoski, *Omaha Beach: D-Day, June 6, 1944*, 75.

<sup>65</sup> Joseph Balkoski, *Utah Beach: The Amphibious Landing and Airborne Operations on D-Day, June 6, 1944*, 1st ed. (Mechanicsburg, PA: Stackpole Books, 2005), 87.

<sup>66</sup> Balkoski, *Omaha Beach: D-Day, June 6, 1944*, 72.

<sup>67</sup> Ibid., 76.

<sup>68</sup> Ibid., 77.

<sup>69</sup> Ibid., 78.

<sup>70</sup> Air Historical Branch, "R.A.F. Narrative (First Draft), the Liberation of North West Europe, Vol. III, the Landings in Normandy," 61.

<sup>71</sup> Hall, *Case Studies in Strategic Bombardment*, 215.

<sup>72</sup> Ibid.

<sup>73</sup> Ibid.

<sup>74</sup> Ibid.

<sup>75</sup> John Buckley, *Air Power in the Age of Total War* (Bloomington, IN: Indiana University Press, 1999), 160.

<sup>76</sup> Ibid.

<sup>77</sup> Hall, *Case Studies in Strategic Bombardment*, 217.

<sup>78</sup> Ibid., 220.

<sup>79</sup> Richard R. Muller, "Losing Air Superiority: A Case Study from the Second World War," *Air & Space Power Journal*, Vol. 17, no. 4 (2003): 59.

<sup>80</sup> Buckley, *Air Power in the Age of Total War*, 161.

<sup>81</sup> Ibid.

<sup>82</sup> B. Franklin Cooling and United States Air Force Office of Air Force History, *Case Studies in the Achievement of Air Superiority* (Washington, D.C.: Office of Air Force History United States Air Force, 1994), 306.

<sup>83</sup> Air Historical Branch, "R.A.F. Narrative (First Draft), the Liberation of North West Europe, Vol. III, the Landings in Normandy," Diagram 2.

<sup>84</sup> Ibid., 27.

<sup>85</sup> Ibid.

<sup>86</sup> Ibid., 28.

<sup>87</sup> Charles Messenger and Cartographica Limited., “The D-Day Atlas: Anatomy of the Normandy Campaign,” (New York, N.Y.: Thames & Hudson, 2004), 54.

<sup>88</sup> Muller, “Losing Air Superiority: A Case Study from the Second World War,” 60.

<sup>89</sup> Ibid., 61.

<sup>90</sup> Thomas Alexander Hughes, *Over Lord: General Pete Quesada and the Triumph of Tactical Air Power in World War II* (New York: Free Press, 1995), 150.

<sup>91</sup> Richard G. Davis and United States, Air Force, Office of Air Force History., *Carl A. Spaatz and the Air War in Europe, General Histories* (Washington, D.C.: US Air Force Office of Air Force History 1993), Appendix 5.

<sup>92</sup> Air Historical Branch, “R.A.F. Narrative (First Draft), the Liberation of North West Europe, Vol. III, the Landings in Normandy,” 64, 117.

<sup>93</sup> Ibid., 64.

<sup>94</sup> Ibid., 119.

<sup>95</sup> Ibid., 122.

<sup>96</sup> Ibid.

<sup>97</sup> Ibid.

<sup>98</sup> Balkoski, *Omaha Beach: D-Day, June 6, 1944*, 89.

<sup>99</sup> Ibid., 90.

<sup>100</sup> Air Historical Branch, “R.A.F. Narrative (First Draft), the Liberation of North West Europe, Vol. III, the Landings in Normandy,” 42.

<sup>101</sup> Balkoski, *Omaha Beach: D-Day, June 6, 1944*, 87.

<sup>102</sup> Ibid.

<sup>103</sup> Balkoski, *Utah Beach: The Amphibious Landing and Airborne Operations on D-Day, June 6, 1944*, 88.

<sup>104</sup> Hughes, *Over Lord: General Pete Quesada and the Triumph of Tactical Air Power in World War II*, 112.

<sup>105</sup> Ibid., 113.

<sup>106</sup> Balkoski, *Utah Beach: The Amphibious Landing and Airborne Operations on D-Day, June 6, 1944*, 87.

<sup>107</sup> Ibid., 90.

<sup>108</sup> Ibid., 88.

<sup>109</sup> Ibid., 91.

<sup>110</sup> Ibid.

<sup>111</sup> Ambrose, *D-Day, June 6, 1944: The Climactic Battle of World War II*, 246-7.

<sup>112</sup> United States, Joint Chiefs of Staff, *Joint Doctrine for Targeting, Joint Pub; 3-60* (Washington, D.C.: Joint Chiefs of Staff, 2002), I-5.

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